National Transportation Safety Board
Engineering Factual Bullets

Accident

Vessel: SPV Ethan Allen
Date: October 2, 2005
Location: Lake George, New York
NTSB No.: DCA06MM001

Engineering Group Chairman

Brian Curtis
National Transportation Safety Board
Office of Marine Safety, NTSB
490 L'Enfant Plaza East
Washington, D.C. 20594

Engineering Group Party Representatives

Peter Gionet
New York State Office of Parks, Recreation and Historic Preservation
Empire State Plaza
Agency Bldg. One
Albany, New York 12238

Hugh Quirk
Shoreline Cruises, Inc.

Det. Russell Lail
Warren County Sheriff's Office
1400 State Route 9
Lake George, New York 12845

Derek Walden
Director of Customer Support
Cummins MerCruiser Diesel, LLC
4500 Leeds Ave., Suite 301
Charleston, South Carolina 29405

Mike Linsdau
Director of Sales & Marketing
Hypro Pumps
375 Fifth Ave. NW
New Brighton, MN 55112

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SUMMARY OF EVENTS

On October 2, 2005, about 1450, the NY state certified small passenger vessel *Ethan Allen* was touring Lake George with 47 passengers and one crewmember on board. The crewmember was a NY State licensed master. All of the passengers were traveling together as a group.

The vessel proceeded northbound and approached an area on the lake called Cramer Point when the master began a turn to starboard. The vessel heeled to port and capsized. After remaining inverted on the surface for a short period, the vessel subsequently sank. The master and 27 passengers survived. Twenty passengers died.

CREW INFORMATION

Dockworkers

- Dockworkers rarely ride vessels as crewmember unless no one else available
- Responsibilities, according the dockworker interviews, when they did ride vessels was to handle lines, make sure the passengers have a nice ride, and to keep an eye out for obstructions along the waterway

VESSEL DESCRIPTION

Hull

- Vessel model: Dyer 40
- Length: 38’
- Beam: 12’
- Draft: 5’
- Fiberglas construction
- Watertight bulkhead separating aft engine space from forward fuel tank/storage space
- Single shaft propulsion drive, 3 bladed propeller, single rudder

Operator’s Engine and Steering Controls

- The operator’s station was situated stern starboard side
- Engine speed controlled by single lever control mounted at operator’s console. It was found positioned full ahead following the accident.
- Steering system consisted of steering wheel at operator’s console varying the vessel’s rudder position. This was accomplished by the use of a shaft and universal joints, which connected the steering wheel to a rudder quadrant (positioning hardware device). As the operator changed the wheel’s position, it thereby repositioned the quadrant, which was directly connected to the upper end of the rudder shaft.

- Investigators tested steering with vessel out of water. Tested satisfactorily
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    - Steering quadrant and associated steering linkage hardware were inspected, and found to be free of an visable corrosion and/or mechanical damage.

Propulsion

- Engine
    - Cummins MerCruiser Diesel-manufactured 6 cylinder inline turbocharged diesel
    - Model 6BT5.9M
    - Horsepower: 210
- Propeller/rudder arrangement
    - Conventional single rudder/single shaft configuration with a 3 blade propeller
    - ~ 1 ½” Metal pipe comprised skeg
- Engine had been replaced several years back by owner
    - Not sure when changeout was performed, as COI still indicated old engine, owner, following repeated requests, could not produce any records pertaining to the changeout, and engine was purchased used from private party

- Previous engine was a 6 cylinder Lathrop, model LERV-D110, 110 HP diesel engine. This engine is still listed on the vessel's COI as the current Ethan Allen engine.
- Both old and new engines were approximately same size physically

- The Captain's interview statements indicated no problem with the engine during the voyage, and that he had never had a problem with it in the past. In the interviews conducted of company personnel, all indicated that this engine was very reliable and strong.

ENGINE SPACE OBSERVATIONS

Bilge Pump

- Vessel had one bilge pump mounted on the forward port bulkhead in the engine compartment, just below the deck level.
- Discharge piping lead directly out through port side of the hull, exiting just below the gunwale.
- Could take suction from either engine compartment or the compartment forward of it, depending on Y-valve selector setting. Post-accident, the selector valve was found in the position where it would take suction from the space forward of the engine compartment.
- Bilge pump did not have a "pump running" indicator at the operator's station

- Pump did not have an automatic start switch installed
    - Company personnel said they would not pump water into the lake due to environmental concerns
- Vessel did not have a “high bilge level” alarm
- According to NYS Regulations of the Office of Parks, Recreation, and Historic Preservation, in part 449.3, it states that for public vessels between 26 and less than 40 feet in length, they are only required to have a 10 GPM bilge pump. It does not require visual indicators for the operator that the bilge pump is running, nor does it require an automatic start switch for the pump, or a high bilge level alarm.

Engine wet exhaust system

- Vessel employed a “wet exhaust” system, meaning the engine’s raw cooling water (lake water) was injected into the exhaust gas piping after the exhaust gases exit the engine’s exhaust manifold. This mixture of exhaust gases and cooling water then flow through a common pipe, and exit through the stern. This exhaust line exited the stern of the vessel
- Leaks were found in the exhaust piping at the point where the cooling water mixed with the exhaust gases.
    - Several pinhole leaks were identified in this pipe by conducting simple onscene testing by introducing fresh water back through the stern’s

exhaust pipe until water was seen leaking from these small holes in the engine's exhaust pipe approximately one foot behind the engine at the point where the engine's raw (lake) cooling water was injected into the exhaust gas stream.

- It was evident that the exhaust line had been repaired several times previous to this in that there were several weld bead "passes" on the pipe in this same immediate area, indicating past repairs had been conducted in this same area for this problem.
- From the aforementioned simple water test, it was also noted that the "flapper" in the check valve in the wet exhaust line had eroded to the point where it would allow lake water back into the stern's exhaust pipe (maintenance oversight item).

Main engine raw water pump

- Pumps water from outside of vessel, through the engine's heat exchanger, acting as a cooling medium, to cool the engine's jacket water circuit.
- Mounted directly on port side of Cummins main engine
- Ethan Allen's engine contained 1 raw water pump
- Pump was observed post-accident to have a gap in its housing between the pump base and its impeller housing
  - The impeller housing was held in place by 3 hex head bolts spaced about the housing's periphery
  - The 2 lower bolts were visibly backed off of the pump housing

    - The measured gap at the bottom of the pump was .076” at its widest point
    - Pump manufacturer was Sherwood, a subsidiary of Hypro Pumps, Inc.
- Pump was removed for further testing and examination at Charleston, SC, and at the NTSB lab in Washington
- Pump had been changed out a few months previous to the accident due to mechanical issues. No exact cause for the changeout could be determined during interviews of Shoreline company personnel who had performed the work. Shoreline could not produce maintenance documentation to identify the date it was changed out, only an invoice for the pump’s replacement dated July 12, 2005.

Other Engine space Observations

- Main engine showed no visual signs of physical damage, aside from previously-mentioned raw water pump having a gap in its housing (engine was not test-run post-accident)
- Sea strainers assembly appeared clean and free of debris, with no signs of damage to the Plexiglas strainer bodies
- Checked all engine space hoses and piping for signs of wear, holes, or abrasions. None evident.
- Checked space for hull damage/penetrations from accident, and found no evidence inside the space of either.

FORWARD SPACE BELOW DECK OBSERVATIONS

- The space contained the vessel's steel 100 gallon capacity fuel tank, positioned aft at the turn of the bilge, sitting on and supported by a piece of plywood underneath.
- There were a total of 21 lead "bricks" found in the space. Each had dimensions of 3 ¼" x 3 ¼" x 14" long.
    - Several of these bricks were later weighed and found to be 55 ½ pounds each.
    - 14 were found situated under the fuel tank's supporting plywood. The remaining 7 were found scattered in various locations on the port side in the space following the accident. From interviews with company employees, they recalled them originally being positioned around the fuel tank, sitting atop the tank's plywood base on each side of the tank.
- There was various data-collecting equipment strewn about the space belonging to the Floating Classroom program, an educational program run by the Lake George Association which periodically used the Ethan Allen to go out and collect lake water data.

PREVENTIVE MAINTENANCE / MAINTENANCE RECORDS

- No formal vessel maintenance plan
- Workers didn't keep or submit records of the repairs or maintenance they would perform on the small (Ethan Allen, Algonquin, deChamplain) boats

- No maintenance records, electronic or hardcopy, were kept by Shoreline Cruise of routine maintenance or repairs performed on the small boats, according to owner
- No one individual who the captains or deckhands would report maintenance items to in order to get work done. Captains could convey maintenance concerns directly to deckhands or mechanics who were free to effect repairs, without necessarily reporting these repairs to management.
- There was no mechanism for reporting and tracking consumed spare parts in the event of a repetitive part failure
- Company mechanics not aware of any maintenance logs being kept on these small vessels. According to a mechanic, “it’s all word of mouth”
- There were no written procedures or guidelines for scheduled maintenance or unplanned repairs as to whom to report it to, or as to how to perform a particular maintenance task.

POST-ACCIDENT TESTING

Vessel placed in water 10/10/05 to test for hull’s watertight integrity observations-

- The Ethan Allen was trailered to Shoreline’s lakeside facility the morning of Oct. 5th, put in the lake, and secured dockside to inspect the hull below decks for any signs or indications of water ingress
- Once vessel was in the water, checked all spaces below decks for any sign of water ingress. Let vessel sit in water dockside for approximately 20 minutes as

checks were conducted, and found no signs or evidence of water ingress from outside of the hull into the vessel.

- Checked both steering and propulsion shaft packing gland for water ingress. None identified.
- Checked engine's raw water pump inlet strainer, fittings, and attached hoses for any signs of leaks, found none.
- Checked for any hull damage, cracks, etc. where lake water may be entering the hull, and found no evidence of any ingress.
- Checked the forward hold space (space forward of the engine compartment), and found no signs of water ingress.
- Checked aft spaces containing the steering quadrant and rudder shaft packing, and found no evidence of water ingress.
- While the vessel was in the water at this time, the Naval Arch. Group also obtained freeboard dimensions about the vessel.

Raw Water pump testing December 20, 2005, in Charleston, SC

- On December 20, 2005, the Ethan Allen Engineering group attended testing of the vessel's raw water pump's performance and capabilities when mounted on an identical Cummins engine at Cummins test facility in Charleston, SC.
- Various tests were run with a new Sherwood identical pump connected to the engine in one of the facilities test cells. We used this pump so as not to damage

the Ethan Allen's pump, as this pump was scheduled for further examination at the NTSB laboratory at a later date.

- All tests were conducted throughout the day of December 20, 2005. All pump flow data was achieved via 2 ISO calibrated flow sensors located before and after the raw water pump in the flow circuit. Supply water was maintained at approx. 68 degrees F throughout testing, simulating the lake water temperature the day of the accident.
- Summary of day's test results as follows:
    - Pump was unable to establish suction and flow unless supply water level was above that of the pump centerline.
    - Any time the pump was operated with no flow through it, it would emit white smoke due to the internal heat being generated within the pump.
    - With no flow through the raw water pump, with the dynamometer load simulating that of the Ethan Allen at 50 horsepower(which was calculated by Cummins) applied, the engine could only sustain itself for approximately 4 minutes without overheating, and shutting itself down due to high cooling water temperature.
    - While pump had gap equivalent to that of the Ethan Allen's pump introduced with engine running, and the supply tank water level was at or **above** the centerline of the pump, the pump was leaking .2-.3 gpm for any given test.
    - Pump flow rates with no gaps were 1 gpm/100 rpm of engine speed.

Examination of vessel's 2 raw water pumps at NTSB Lab

- As per RE lab's factual bullets in Derek Nash's email of 2/1/06

VESSEL DAMAGE

- The Ethan Allen was trailered to Floyd Bennett Memorial Airport in the nearby town of Glen Falls the evening of Oct. 3rd, the day following the accident, once it was raised from the bottom of Lake George and made ready for transport. The following day the vessel was inspected for damage caused by the capsizing and subsequent sinking in the hanger where it was being housed. Inspecting the hull's exterior, there were no visible signs of accident-related damage on any of its fiberglass outer hull.
- An external examination of the vessel's rudder, skeg, propeller, and drive shaft components showed no signs of damage.
- On the main deck, the forward port side window pane was found broken.
- Also on the main deck, all passenger benches were bolted to the main deck, with no signs of having been broken, or having sustained damage during the accident.
- The large hatch cover immediately over the main engine was missing from the vessel, but was later recovered by another party on the lake and returned to investigators.
- In the main engine compartment, the following damages were noted;

- The entire space was coated with what was apparently engine lubricating oil.
- The Ethan Allen's propulsion engine showed no evidence of physical component damage sustained during the testing, although as far as its mechanical wellbeing is concerned, it must be understood that the engine had been rolled over and submerged during the capsizing/sinking, and would certainly require further internal examinations to fully assess the damages encountered as a result of the accident. The only physical abnormality observed on the engine was the raw water pump discussed earlier in these bullets.
- The vessel's 2 12 volt batteries were found displaced, still cabled together, and had come to rest slung over the exhaust pipe approximately 3 feet aft of the engine.
- Aside from the few small items stored in the engine space being strewn about, there were no other indications of damages associated with the accident.

- In the below decks space forward of the engine compartment, the following damages were noted;
  - The vessel's fuel tank was located in this space, and was sounded for level in the days following the accident. When sounded, it was determined that the level in the tank was 3" above the tank boundaries, and therefore the fuel tank had encountered lake water ingress.

- The various lead ballast bricks in the space had been strewn about during the accident, and there movement had caused only minor cosmetic damage to the interior boundaries of the compartment.